Management and health constraints for small-scale dairy production in Africa

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Summary

MILK IMPORTS TO *Africa increased sixfold in the last decade and now exceed 2 million tonnes of liquid milk equivalent per year, accounting for about 30% of total consumption. They have a present value of about US$ 800 million. Substantial increases in milk production in Africa are feasible. This paper summarises the major environmental constraints to increased production of dairy products and discusses alternative technical and organisational concepts for encouraging greater milk production.*

Cattle in Africa are kept primarily for milk production. In pastoral societies, milk is the key product, with meat of only secondary importance. On smallholder subsistence farms, milk is universally important.

Three main approaches to dairy development are in use: large parastatal farms, medium-sized dairy farms in peri-urban areas and organised milk collection from subsistence farmers. In each system, output is constrained by the restricted supply of dairy stock, poor animal health, inadequate feeding, poor marketing facilities and lack of extension and adequately trained personnel.

The tsetse-transmitted disease, trypanosomiasis, which is found in about 40% of sub-Saharan Africa, is a major constraint to increased milk output and is largely responsible for the substantial imports of dairy products, particularly to West Africa.

Under traditional management, indigenous breeds of cattle are more productive than exotic breeds. However, in higher-altitude and more temperate areas of sub-Saharan Africa, crossbred cattle can out-yield indigenous stock fourfold, provided that modest improvements are made in their management and nutrition. Maintaining genetic stability in these crossbreds is, however, a major problem. Making better use of local feed resources, particularly poor-quality feeds, at the small-farm level is a promising strategy for increasing milk production. Management problems common to all dairy systems in sub-Saharan Africa include dry-season feeding, calf rearing, small-scale milk processing and reliable vaccine supplies.

Introduction

The slow economic growth of the countries of sub-Saharan Africa is an issue of major world concern. As agricultural output declined, food imports increased and currently meet about one-fifth of the region's cereal needs. Milk imports now exceed 2 million tonnes per year, representing about 30% of total consumption. Over the last decade, milk imports increased sixfold and their present annual value is about US$ 800 million (von Massow, 1985).

Although Africa's overall economic progress is disappointing, important changes are occurring in the agricultural sector. The most obvious is the decline in the relative contribution of

agriculture to GDP with a rapid increase in market demand for food, particularly that of livestock origin. Consumers in all developing countries show a high propensity to spend additional income on meat and milk.

Complementarity of crop and livestock production

Total cereal production in sub-Saharan Africa is about 42 million tonnes per annum, and is increasing by an average of only a little over 1% annually. There are, however, very large differences in agricultural growth among African countries, with some showing much larger increases than others.

Using data from *FAO Production Yearbooks,* an analysis of the trends in cereal and livestock production over the last decade in the countries of sub-Saharan Africa indicates that:

- There is a significant correlation between changes in total cereal production and in cattle numbers;
- Changes in area cultivated and cattle numbers are much more highly correlated than crop yields per unit area and cattle numbers; and
- Each extra animal in the cattle population is associated with an extra 0.25 ha of cropped land and about 200 kg extra annual grain output.

These observations, based on the African experience, are also noted elsewhere. In India's northwestern states, where large increases in wheat and rice production have occurred, one finds correspondingly large increases in milk production. In other Asian countries where rice production has increased greatly, large increases in meat and milk production have been reported. The reasons for this association of increases in food-grain and livestock production are simple and several.

1. Availability of money. On subsistence farms, cash income is extremely low because almost all produce is consumed on the farm. Consequently, there is little money available to buy fertilizer, better seed, crop protection measures or irrigation water. In the absence of a good credit mechanism, food-grain production can only be increased by finding cash to purchase these inputs. This is most readily achieved by selling more livestock products. An upward spiral can be started by increasing sales of livestock, thus generating the purchasing power needed to produce more crops. The catalyst in the system is livestock, and the initial development objective is to increase their output to produce the funds required to increase crop production.
2. Cattle provide draught power. Working bullocks are the pivotal point of farm production in many African countries, and the type and number of livestock kept by farmers are largely determined by their need for draught power for land cultivation. Typically, one pair of oxen can cultivate 2 to 4 hectares of land per year. Recent studies by ILCA in Ethiopia show a marked increase in the area cultivated by each family as bullock numbers increase. These results also show a marked change in cropping patterns with changing availability of bullock power.
3. Market demand. As the size and wealth of the population increase, the demand for more and better food escalates rapidly. Meat and milk are most people's idea of better food, and more and better cattle provide more meat and milk.

Increasing milk production

An essential starting point to any discussion on how to increase milk production is an understanding of why African farmers keep cattle. Milk production is a key reason, but manure for fuel and fertilizer, draught power, meat production, drought insurance and capital saving are also important reasons. Attempts to increase milk production must take account of all these factors, and also of the need to use livestock as the catalyst in generating income and savings for farmers with no alternative source of cash. Proposals for the development of the cattle sector must also be extremely low-cost if they are to be adopted by Africa's small farmers.

Three main approaches to increasing milk production have been used in recent years. These are:

- Large parastatal dairies using specialised dairy cattle for intensive milk production;
- Medium-sized dairy farms in the private sector, close to major urban centres; and
- Organised milk collection from large numbers of traditional subsistence farmers, usually associated with some upgrading of cattle by artificial insemination and the provision of animal health and advisory inputs.

Large parastatal farms offer opportunities to maximise the impact of specialised management skills, to produce a high-value product close to market outlets, to minimise transport and input supply problems and to effect substantial economies of scale. The problems such farms present are associated with a reliance on purchased feed rather than pastures and crop residues, their capital intensiveness and their lack of impact on rural cash flows and productivity. The intensive nature of milk production in these units usually leads to high production costs and to the need for subsidies to ensure continuing viability. Where such farms are used as bull breeding units, AI and cooperative service centres, and as focal points for the collection and processing of more widespread milk supplies, they play a valuable role in the national dairy development strategy. Their usefulness as research or demonstration centres is, however, very limited as the production technology used is not applicable to the traditional livestock producer.

The smaller, semi-intensive specialised dairy units developed within the private sector present a similar spectrum of advantages and disadvantages. One important type of semi-intensive dairy unit is the 'flying herd' which is characteristic of many urban dairies. Typically, recently-calved cows are brought into city stables and fed and managed for maximum milk production. The resulting problems of manure disposal and feed transportation usually make the flying herd a second-best solution to providing adequate milk supplies.

Small dairy farms just outside major towns avoid many of the problems associated with the city units, but these peri-urban dairies also incur many costs that traditional mixed farmers can avoid. Most attempts to establish peri-urban specialist dairies in Africa and Asia have not been particularly successful.

The outstandingly successful experience of dairy development in South Asia is based on the so-called Anand model (Brumby, 1981). This concept began on a small scale about 30 years ago with the establishment of a small dairy-producers' cooperative in the town of Anand in west India. The success of this small cooperative quickly led to similar grass-roots movements in many other Indian states, and now more than 10 000 dairy cooperatives in Indian villages, with 2 million members, collect and process some 2.5 million litres of milk daily.

This cooperative movement is organised in three tiers: village dairy societies, unions of about 400 village dairy societies and a federation of several unions in each state. The whole system is owned by the primary milk producers who are small peasant farmers or landless owners of one or two cows. Two semi-autonomous government agencies— the National Dairy Development Board and the India Dairy Corporation—provide technical and financial assistance to the system.

This cooperative structure provides an integrated system for marketing and processing milk. The village cooperative society buys milk twice daily from its 100 to 200 members on commission at its village collection centre. The milk is immediately tested for fat content and taken by truck, without cooling, to the union dairy where it is pasteurised, cooled and either shipped to urban markets or processed into dried milk and butter. The union dairies are modern plants of relatively large capacity (100 000 to 400 000 litres per day). The entire supply for each comes from the very large number of small farmers making up the basic village societies.

Every member of the village cooperative has access to a daily artificial insemination service, to veterinary services, to concentrate feed supplements and to supplies of seed of forage crops. The success of the movement lies in a reliable and profitable outlet for all milk produced, with prompt payment based on milk quality as determined by individual fat tests, and technical assistance to increase production.

Why should this cooperative venture have succeeded so well when so many other cooperative structures have failed? The reasons for the success of the Anand model can be simply summarised. It provides a soundly conceived and financially viable package of technical services to the producer, economies of scale at critical points in the marketing system, dedicated leadership and well-trained support staff.

Animal health problems

Animal health problems are closely linked to the kind of environment in which the herd is kept, the management methods used and to genetic factors related to disease resistance in the animal population. In Africa, low-cost, effective vaccines are usually available to protect against rinderpest, contagious bovine pleuropneumonia and local strains of foot-and-mouth disease. Such sporadic or regional diseases as anthrax, blackleg and haemorrhagic septicaemia can also be prevented by regular immunisations, but vaccines for these diseases are not always of high quality or uniformly available. With some vaccines, the costs may exceed the expected benefits (McCauley, 1983).

Closed management systems, in which no animals are brought into the herd from outside sources, greatly reduce the likelihood of infection by many diseases, and viral and bacterial infections that are spread by contact can be prevented. This offers an alternative to the strict use of vaccines and usually protects the herd from the severe effects of such diseases as infectious bovine rhinotracheitis, mucosal disease and, probably, salmonellosis. Such persistent problems as brucellosis and tuberculosis can be controlled by a combination of eliminating infected animals and maintaining a closed herd (Nicoletti, 1984).

But in small dairy herds in warm climates, vector-borne and parasitic diseases are the most common health problems, and the strict environmental controls necessary to eliminate these are not practicable. Many of these diseases cannot be prevented and treatment or control is expensive. Several, including trypanosomiasis and East Coast fever, are so widespread and

often beyond economically feasible methods of control that they are prime subjects of major research efforts (Gray, 1984). Others are less prevalent but even more enigmatic: these include ephemeral fever, heartwater disease, Rift Valley fever and lumpy skin disease. There are, however, three ways in which we can often live with this large group of diseases through understanding and compromise.

The first is to appreciate the too-often-ignored genetic advantage off indigenous cattle. The value of these, in tsetse-infested areas particularly, is well documented (see Brumby and Trail, 1986). The need for large increases in milk production has often led to the importation of exotic breeds, and nearly as often ended with overwhelming disease problems. The innate disease resistance of indigenous cattle, coupled with adequate diets, can offer the prospect of increased production with some assurance of permanent gains.

The second is to understand and take advantage of what can be called an 'endemic-equilibrium' state of disease. This state of tolerance between the parasite and host occurs with most of the tick-borne diseases when animals are exposed to them while young and partly resistant; they can thus acquire immunity that protects them in their usually susceptible older age. Two of the four important tick-borne diseases, anaplasmosis and babesiosis, become quite benign under this adaptive behavioural pattern. There is also some evidence that East Coast fever acts in a similar manner with indigenous cattle.

The third important epidemiological truth of practical importance is that parasitism is the normal state. This applies to many parasitic diseases. It is normal for hosts to have parasites and, if the levels of infection are not excessive and the host is not malnourished, their relationship is often more beneficial than pathogenic. This is due, again, to factors of resistance and immunity (Urquhart, 1980). Related to this is the unique fact that metazoan parasites do not replicate within their hosts. Because of their complex life cycles, associated with sexual reproduction and multiple developmental stages that require different environments, the number of metazoan parasites within a host is directly related to the level of transmission (Warren, 1981). Transmission levels can be regulated through management methods based on an understanding of parasite life cycles. This knowledge is not fully appreciated or widespread. We are, instead, conditioned to view infection as synonymous with disease and treatment with cure. These are false and unrewarding beliefs.

Disease is an important constraint on all forms of livestock production and especially for calves (Perry et al, 1984), which frequently suffer from respiratory and enteric diseases. Chronic diseases such as dermatophilosis greatly depress milk production (Oduye, 1975) and increase mortality in all age groups.

Calf rearing

Allowing limited suckling of cows by their calves has a great deal to commend it as a calf-rearing technique. Supplementation of a small milk intake with leguminous forage, oilseed cake or concentrate mix increases calf growth appreciably, provided that sufficient drinking water is available, a matter that is often overlooked under smallholder conditions. This water requirement amounts to about 5.5 litres per kg of DM consumed.

Mortality in calves is also considerably decreased as increases in daily weight gain are achieved, and the subsequent rearing of weaned calves is greatly facilitated by supplementation with legume forage, oilseed cake and/or molasses/urea block.

Research on milk production

In considering how livestock research can most usefully support the economic development of a specific region, it is important to establish what type of organisation of livestock production is likely to prevail in the next 20 to 30 years. The research problems presented by the alternative milk production systems are very different and it makes little sense to embark on a specific research programme unless a sound concept is developed of what future production patterns are likely to be. It is likely that traditional smallholder farming will continue to predominate in Africa, and that a cooperative structure linking and providing services to these small farms will emerge. Given these assumptions, it is useful to consider what type of research into increased milk production is likely to be most cost effective and how it might best be organised.

In all African countries, calving patterns show marked seasonal variations. Peak calving periods are greatly influenced by seasonal patterns of rainfall and annual feed supplies. Milk supplies and, more importantly, production costs show similar seasonal variations. Do we accept this situation, do we try to modify it by supplementary feeding and new forage crops or do we produce milk only for that part of the year when feed is plentiful, conserving the seasonal surplus as milk powder and butter for use during the season in which feed supplies are scarce?

Milk can be produced cheaply by feeding low-energy diets based on crop byproducts, supplemented with some leguminous fodder, a little oilseed cake and urea, preferably in a molasses block complex. The optimal milk yield per cow depends on its breed type, overall environmental stress and the local market value of milk. The optimal feeding level and balance of feed types in these various circumstances is largely unexplored, and little is known about the relationship between incremental levels of feeding and incremental milk yields. Data to indicate the optimal stock density per unit of arable land are inadequate, as are data about the area of fodder crop needed for each milk cow in different cropping situations and on different sizes of farm.

The much discussed question of the degree of crossbreeding desirable is now reasonably clear; animals with 50 to 75% exotic blood usually outperform more extreme crosses on a lifetime basis, but how best to maintain this level of exotic blood is unresolved. Should F_1 bulls be used for each generation? Should a new breed be fashioned by intense mating of the crossbreds? Would crisscrossing be practicable? And how do we ensure a maintenance of draught capability? Genetic interactions and maternal effects also complicate the analysis of crossbreeding data, as does the small size of the herds in which field records are obtained. Within-herd comparisons are rarely possible in small herds, and using records across farms involves many additional sources of variation. Results at ILCA show that individual lactation milk records from small herds in Africa, as in Asia, have a coefficient of variation of about 30%. This high variability makes progeny testing largely impractical. It also complicates attempts to conduct experiments within the herds of small farmers.

In both Africa and Asia it is evident that some farmers are much better than others, that crossbred cows can perform better than local stock if environmental constraints are reduced, that certain forms of milk production have a much better success record than others and that sales of milk and milk products often provide the main source of farm cash income, the expansion of which is critical to increasing total farm output.

It is also evident that unattractive prices and inappropriate policies frustrate production increases in many circumstances. Important as these policy issues are, the increase in food

output so badly needed depends greatly on the development and adoption of new and simple technology. It also depends on the promotion of the organisational and entrepreneurial systems needed to put better technology into productive effect, and of building a research structure appropriate to local farming patterns. The Anand model of dairy development provides an excellent example of how effective smallholder milk production can be in promoting economic development.

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